

Application No.:09/761,514
Amendment dated: July 6, 2004
Reply to Office Action of April 5, 2004

This listing of claims will replace all prior versions and listings of claims in this application:

a.) Listing of Claims

1. (previously presented) A micro optical train manufacturing process, comprising:
installing optical components onto an optical bench to form an optical train;
measuring positions of the optical components of the optical train; and
aligning the optical components of the optical train in response to the positions.
2. (original) A process as claimed in claim 1, wherein the step of installing the optical components comprises solder bonding the optical components to the optical bench.
3. (original) A process as claimed in claim 1, wherein the step of installing the optical components comprises eutectic solder bonding the optical components to the optical bench.
4. (original) A process as claimed in claim 1, wherein the step of installing the optical components is performed by a precision placement and bonding machine.
5. (original) A process as claimed in claim 1, wherein the step of installing the optical components is performed in a solder reflow oven.
6. (original) A process as claimed in claim 1, further comprising characterizing an optical property of at least some of the optical components prior to installing the optical components on the optical bench.
7. (previously presented) A process as claimed in claim 6, wherein the step of aligning the optical components of the optical train is further performed in response to the optical property.

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8. (original) A process as claimed in claim 1, further comprising determining focal lengths of at least one of the optical components prior to installing the optical component on the optical bench.

9. (original) A process as claimed in claim 1, further comprising assembling optical components prior to attaching the optical components on the optical bench.

10. (original) A process as claimed in claim 9, wherein the step of assembling the optical components comprises solder bonding optical elements to mounting structures.

11. (original) A process as claimed in claim 9, wherein the step of assembling the optical components comprises thermally bonding optical elements to mounting structures.

12. (original) A process as claimed in claim 1, wherein the optical components are installed on the optical bench to a precision of less than 4 micrometers.

13. (original) A process as claimed in claim 1, wherein the optical components are installed on the optical bench to a precision of less than 1 micrometer.

14. (original) A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining positions of the optical components relative to reference marks on the optical bench.

15. (original) A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining distances between the optical components.

16. (original) A process as claimed in claim 1, wherein the step of determining the positions of the optical components is performed by a vision system by reference to predetermined features of the optical components.

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17. (original) A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining positions of optical elements of the optical components.
18. (original) A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining positions of mounting structures of the optical components.
19. (original) A process as claimed in claim 1, wherein the step of aligning the optical components comprises passively aligning the optical train.
20. (original) A process as claimed in claim 1, wherein the step of aligning the optical components comprises plastically deforming the optical components.
21. (previously presented) A process as claimed in claim 1, further comprising, after aligning the optical components in response to the positions, actively aligning the optical components of the optical train.
22. (original) A process as claimed in claim 21, wherein the step of actively aligning the optical components comprises deforming the optical components.
23. (previously presented) A process as claimed in claim 1, further comprising, after aligning the optical components in response to the positions, transmitting an optical signal through the optical train and further aligning the optical components of the optical train in response to the transmission of the optical signal through the optical train.
24. (previously presented) A process as claimed in claim 23, wherein the step of aligning the optical components in response to the optical signal comprises deforming the optical components.
25. (previously presented) A process as claimed in claim 23, wherein the step of aligning the optical components in response to the optical signal comprises deforming mounting structures of the optical components.

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26. (previously presented) A process as claimed in claim 23, wherein the step of aligning the optical components in response to the optical signal comprises aligning the optical components to maximize a level of the optical signal that is transmitted through the optical train.

27. (previously presented) A process as claimed in claim 23, wherein the step of aligning the optical components in response to the optical signal comprises aligning the optical components to maximize a side mode suppression ratio of a tunable optical filter in the optical train.

28. (previously presented) A process as claimed in claim 1, further comprising characterizing a position of an optical element on a mounting structure of the optical components prior to installing the optical components on the optical bench by reference to light that is transmitted through the optical element.

29. (previously presented) A micro optical train manufacturing process, comprising:

characterizing positions of optical elements on mounting structures of optical components prior to installing the optical components on optical benches by reference to light that is transmitted through the optical elements; installing optical components onto the optical benches to form optical trains; measuring positions of the optical components of the optical trains; and aligning the optical components of the optical trains in response to the positions of the optical components in the optical trains and the position of the optical elements on the mounting structures of the optical components.

30. (previously presented) A process as claimed in claim 29, wherein the step of installing the optical components comprises solder bonding the optical components to the optical bench.

31. (previously presented) A process as claimed in claim 29, wherein the step of installing the optical components comprises eutectic solder bonding the optical components to the optical bench.

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32. (previously presented) A process as claimed in claim 29, wherein the step of installing the optical components is performed by a precision placement and bonding machine.
33. (previously presented) A process as claimed in claim 29, wherein the step of installing the optical components is performed in a solder reflow oven.
34. (previously presented) A process as claimed in claim 29, further comprising determining focal lengths of at least one of the optical components prior to installing the optical component on the optical bench.
35. (previously presented) A process as claimed in claim 29, wherein the step of measuring the positions of the optical components comprises determining positions of the optical components relative to reference marks on the optical bench.
36. (previously presented) A process as claimed in claim 29, wherein the step of measuring the positions of the optical components comprises determining distances between the optical components.
37. (previously presented) A process as claimed in claim 29, wherein the step of measuring the positions of the optical components is performed by a vision system by reference to predetermined features of the optical components.
38. (previously presented) A process as claimed in claim 29, wherein the step of measuring the positions of the optical components comprises determining positions of optical elements of the optical components.
39. (previously presented) A process as claimed in claim 29, wherein the step of measuring the positions of the optical components comprises measuring positions of the mounting structures of the optical components.
40. (previously presented) A process as claimed in claim 29, wherein the step of aligning the optical components comprises passively aligning the optical train.

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41. (previously presented) A process as claimed in claim 29, wherein the step of aligning the optical components comprises plastically deforming the mounting structures.
42. (previously presented) A process as claimed in claim 29, further comprising, after aligning the optical components in response to the positions, actively aligning the optical components of the optical train.
43. (previously presented) A process as claimed in claim 42, wherein the step of actively aligning the optical components comprises deforming the optical components.
44. (previously presented) A process as claimed in claim 29, further comprising, after aligning the optical components in response to the positions, transmitting an optical signal through the optical train and further aligning the optical components of the optical train in response to the transmission of the optical signal through the optical train.
45. (previously presented) A process as claimed in claim 44, wherein the step of aligning the optical components in response to the optical signal comprises deforming the mounting structures.
46. (previously presented) A process as claimed in claim 44, wherein the step of aligning the optical components in response to the optical signal comprises deforming mounting structures of the optical components.
47. (previously presented) A process as claimed in claim 44, wherein the step of aligning the optical components in response to the optical signal comprises aligning the optical components to maximize a level of the optical signal that is transmitted through the optical train.
48. (previously presented) A process as claimed in claim 44, wherein the step of aligning the optical components in response to the optical signal comprises

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aligning the optical components to maximize a side mode suppression ratio of a tunable optical filter in the optical train.

49. (new) A process as claimed in claim 1, wherein the step of measuring the positions is performed after the step of installing the optical components, and step of aligning the optical components is performed after the step of measuring the positions.

50. (new) A process as claimed in claim 29, wherein the step of measuring the positions is performed after the step of installing the optical components, and step of aligning the optical components is performed after the step of measuring the positions.